

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Global Food Security and Hunger -- Integrated Pest Management

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
136	Conservation of Biological Diversity			48%	
211	Insects, Mites, and Other Arthropods Affecting Plants			5%	
212	Pathogens and Nematodes Affecting Plants			5%	
213	Weeds Affecting Plants			5%	
215	Biological Control of Pests Affecting Plants			10%	
216	Integrated Pest Management Systems			20%	
312	External Parasites and Pests of Animals			7%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	54.2	0.0
Actual Paid Professional	0.0	0.0	3.8	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	57955	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	228174	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	39634	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- Wrote and disseminated pest control recommendations
- Produced regional management guides
- Communicated research results through pesticide workshops and field days
- Used research results to support FIFRA Section 18c product labeling requests
- Updated pesticide applicator training materials
- Updated training materials for private and commercial pesticide applicators

2. Brief description of the target audience

- Crop producers, dealers, distributors, and crop protection company representatives
- Crop protection companies registration and research personnel
- Montana crop advisory boards
- Private and commercial pesticide applicators
- State of Montana, Montana Department of Agriculture, BLM, USFS, and other government entities

3. How was eXtension used?

COA and MAES researchers worked closely with county extension agents and outreach coordinators to disseminate timely and accurate information about integrated pest management topics and issues.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1553	70000	400	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2012
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	12	64	76

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research citations

Year	Actual
2012	58

Output #2

Output Measure

- Multidisciplinary journal articles published

Year	Actual
2012	62

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Quality in-depth training programs for continuing education on integrated approaches to pest management
2	New IPM options discovered and evaluated per year
3	Number of broad-ranging stewardship practices implemented
4	Passing rate percentage for pesticide application licenses
5	New products registered.
6	Number of potential products/practices evaluated

Outcome #1

1. Outcome Measures

Quality in-depth training programs for continuing education on integrated approaches to pest management

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	59

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

An increase in public concern about food safety, quality, cost, biodiversity, and sustainability and quality of soil, air, and water resources is pushing scientists away from pesticides.

What has been done

Researchers explored new and improved methods to identify and control insects, weeds, and disease challenging Montana farmers. They then conducted 37 face-to-face training sessions for nearly 3,000 members of the Montana agricultural community and 7 webinars for an additional 287 participants. MSU investigators shared low impact pest control options that promote sustainable practices utilizing biological controls.

Results

The MSU research, teaching, and extension team is bringing a real awareness to incorporating targeted grazing into farming systems. Researchers with the targeted grazing program spoke at seven locations educating 241 participants as to the benefits of the program, and they shared information at field days.

Researchers held a pest management tour and visited five locations accompanied by 225 producers.

The IPM instructors shared sustainable ag practices that will better manage diseases, insects, weeds and rodents. The training also focused on the safest and most effective ways to use pesticides.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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136	Conservation of Biological Diversity
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems
312	External Parasites and Pests of Animals

Outcome #2

1. Outcome Measures

New IPM options discovered and evaluated per year

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Producers must continually improve pest management programs to increase productivity and profit. Consumers are demanding farmers use less chemical pesticides for food crops. Integrated pest management research also involves weed mitigation with researchers investigating both herbicides and biological control agents.

What has been done

MSU COA researchers are exploring biological control agents for Russian knapweed, hoary cress, invasive hawkweeds, and rush skeleton weed. Invasive plant species are a serious economic and ecological problem for range and forested lands. Research projects contributed to the selection of potential new control agents and an increased understanding of how to use them. They continued exploring targeted sheep grazing as an economical and ecologically sustainable tool to manage lands with large infestations of invasive plants.

Results

Scientists introduced three new insects into Montana for controlling Russian knapweed and orange hawkweed. Researchers released 20 gall wasps in 2009 and found an equal number of galls infesting the Russian knapweed. Since then the numbers have increased exponentially with

thousands of galls present in 2012.

Researchers confirmed glyphosate resistant kochia populations in Montana. Researchers are working with farmers in Montana to educate them on herbicide-resistant kochia management.

Research findings suggest August is the optimal time to prescribe targeted sheep grazing for spotted knapweed.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

Outcome #3

1. Outcome Measures

Number of broad-ranging stewardship practices implemented

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Weed and insect control is critical to sustainable agriculture in Montana. As the climate changes, Montana is dealing with an increase in noxious weeds, rodents, and harmful insects that impact rangeland and cropland.

What has been done

Investigators focus on broad-ranging stewardship practices and emphasized quality educational programs for farmers and ranchers and other key stakeholders. Weed and insect experts traveled throughout the State offering courses on insect and weed identification, proper pesticide usage,

and suggestions for targeted grazing practices. Researchers also made significant advancements in sex pheromone receptor and wheat stem sawfly research. Advancements were also made toward integrating molecular research with applied entomology.

Results

New online information programs are including more data to assist farmers and ranchers with weed and insect identification. Researchers at MSU identified the molecular basis for evolving ligand specificity of a sex pheromone receptor. This data assisted in advancing the research toward better attacking the wheat stem sawfly.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

Outcome #4

1. Outcome Measures

Passing rate percentage for pesticide application licenses

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Pesticide application training is important for disseminating new data and guidelines. The COA and the Extension Service work closely offering training and application licenses throughout Montana.

What has been done

MSU Pesticide Education Program administered a website which included 250 private applicator programs this year. These programs are meticulously reviewed before awarding continuing

education credits awarded based on meeting the core pesticide education categories: pesticide laws, integrated pest management, calibration, pesticides in the environment, the private applicator license, and pesticide safety. Without available credits private applicators may choose to spray pesticides without adequate training, or to not manage noxious weeds and insect pests through the use of pesticides.

Results

A total of 55 pesticide education presentations were delivered to 2,000 certified applicators across Montana at 42 locations. Presentations included topics of pesticides in the environment, IPM, calibration, pesticide safety, restricted use recordkeeping, mixing and handling, alfalfa weevil IPM, and pesticide poisonings. Fumigant education training targeted 150 applicators with an intense six hours of training. Two train-the-trainer programs targeted 50 local pesticide education trainers. There are approximately 6,600 private applicators this year in Montana.

Thirty-two applicators indicated they would change their behaviors as a result of the education. Changes included applicators protecting themselves and calibrating more often.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

Outcome #5

1. Outcome Measures

New products registered.

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Number of potential products/practices evaluated

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Producers and researchers are evaluating new integrated pest management (IPM) methodologies for controlling pests so they can maintain a competitive position in U.S. and world markets while helping to alleviate global hunger. It is important to develop new strategies in order for the pests to not develop resistance.

What has been done

Investigators evaluated biological control agents like *Muscodor albus*, a plant-swelling fungus, to treat diseases in potato and sugar beet crops. This biological control agent has the potential to replace harmful and toxic biocides currently used in agriculture. Continued evaluating targeted grazing and explored other biological control agents.

Results

This year a COA IPM specialist is credited with educating a field agronomist about stripe rust that was estimated to have impacted 48,000 acres. The advice and education has a predicted economic benefit to growers of \$4 million.

In Meagher County in 2012, a confirmed ID of cutworms in the area allowed a grower to receive a \$179,000 indemnity check, treat the problem, and replant a crop within 72 hours. In addition, the grower harvested an 80 bushels/A barley crop.

MSU COA IPM experts traveled extensively to deliver educational outreach related to cropland entomology. They wrote more than 25 Ag Alerts and several articles in regional magazines, educated growers about current grasshopper outbreaks, and posted four educational modules on the extension webpage. Coordinated and distributed 2000 copies of a Pulse Pest Calendar in Montana and North Dakota to growers and agricultural professionals.

Directly addressed 1,553 people in 21 presentations; 7 appearances on Montana Ag Live with an estimated 10,000 viewers/appearance.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants

215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Appropriations changes
- Public Policy changes
- Government Regulations

Brief Explanation

The demands of producers who grow crops organically require innovative pest and fertility solutions often requiring biocontrols and alternative nitrogen sources. Organic farming and the introduction of non-traditional crops create a need for MSU researchers to delve into new approaches to crop management.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Investigators with the COA and MAES focused on identifying and managing weeds, insects, and diseases, so the agricultural community in Montana can better impact global food security. Field crops are an important foundation for the Montana agricultural industry and revenue exceeding \$2 billion in 2012. The most significant crop in Montana was wheat (5.4 million acres, \$1.4 billion) followed by barley (760,000 acres, \$143 million). The grain supports the livestock industry in Montana, and also the export market. A leading researcher shared that of the growers attending conferences on disease management and fungicide treatment options 65 percent could better identify diseases and had a clearer plan of how to treat them. Educating one field agronomist about stripe rust is estimated to have impacted 48,000 acres with an economic benefit to growers of \$4 million. A direct economic impact of recommendations from researchers at the MSU Schutter Diagnostic lab this year was approximately \$400,000 on 354,000 acres. Requests for assistance were lower, because it was a dry year with fewer disease outbreaks.

Researchers are investigating the sawfly's chemical ecology, and evaluating host plant resistance, pathogens, and cropping strategies. Researchers at MSU identified sex pheromones from hundreds of moth species and are using them to study and trap the insects and disrupt their mating by altering the odorant receptor proteins from male moth antenna.

Researchers are better understanding the diversity, distribution, and activities of pollinators (including alfalfa leafcutter bees) in natural and agricultural ecosystems. The goal is to better understand the value of pollinators and predatory insects in agricultural and natural ecosystems, the effect of land management practices on these insects, and their basic biology.

Integrated management of rangeland invasive plants is also critical. Economically, weeds impact rangeland more than all other pests combined, including billions of dollars

spent on control and reduction in livestock and wildlife carrying capacity. Containing existing populations and restoring rangeland severely degraded by weeds is critical for the ecology and economics of Montana agriculture. This year two studies focused on cheatgrass and how to control it as well as revegetation methodologies. Information was shared through workshops and field days with private and public land managers to improve rangeland health.

Key Items of Evaluation

Scientists introduced three new insects into Montana for controlling Russian knapweed and orange hawkweed: *Jappiella ivannikovi* (a gall midge) and two stem galling wasps. Researchers released 20 gall wasps in 2009 and found an equal number of galls infesting the Russian knapweed. Since then the numbers have increased exponentially with thousands of galls present in 2012.

Researchers at MSU identified the molecular basis for evolving ligand specificity of a sex pheromone receptor. This data assisted in advancing the research toward better attacking the wheat stem sawfly with odor traps and other devices.

An important finding in 2012 was the confirmation of glyphosate-resistant kochia populations in Montana. Kochia is especially troublesome in wheat-fallow cropping systems, because it spreads quickly. Researchers are working with farmers in Montana to educate them on herbicide-resistant kochia management.

Research findings this year supported the suggestion that August is the optimal time to prescribe sheep grazing for spotted knapweed. The increased consumption of the knapweed in August versus July suggested either the knapweed was preferred in August or the ewes were becoming adapted to it.

Researchers spoke to more than 70 participants in a post fire weed control workshop at the conclusion of a fire season in Montana that burned more than 700,000 acres.